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Report on "PCTE '91, the First International Conference on PCTE"

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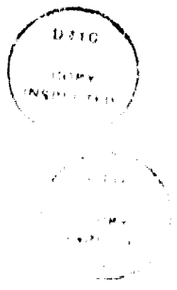
ABSTRACT (UNCLASSIFIED)

The first international conference on PCTE, PCTE '91, was held in The Hague from 25 to 27 September 1991. PCTE is a specification of software services supporting the construction and integration of CASE tools.

This report contains an account of the presentations given during this conference. This account is based on the speakers' overhead sheet presentations and the authors' personal notes.



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SAMENVATTING (ONGERUBRICEERD)

Van 25 tot en met 27 september 1991 werd in Den Haag de eerste internationale conferentie over PCTE, PCTE '91, gehouden. PCTE vormt een software basis voor de constructie en integratie van 'CASE tools'. CASE tools zijn software gereedschappen die de ontwikkeling van programmatuur ondersteunen.

Dit rapport beschrijft de lezingen gehouden tijdens PCTE' 91. De beschrijving van de lezingen is gebaseerd op de overhead sheets van de sprekers en de persoonlijke aantekeningen van de auteurs van dit rapport.

1 INTRODUCTION

The first international conference on PCTE, PCTE '91, was held in The Hague from 25 to 27 September 1991. PCTE '91 was supported by the three main organisations involved in PCTE. These are the European Computer Manufacturers Association, Technical Committee 33 (ECMA TC33), the Independent European Programme Group, Technical Area 13 (IEPG TA-13), and the CEC established PCTE Interface Management Board (PIMB). The conference was organised by the TNO Physics and Electronics Laboratory (TNO-FEL).

Nowadays, it is widely accepted that the use of software engineering tools (CASE-tools[1]) is necessary to master the growing complexity of software production. The support provided by these tools is needed during the whole software life-cycle, from initial requirements capturing until maintenance. To gain full benefit of this tool usage, tools have to be integrated into a so-called Integrated Project Support Environment (IPSE). The Portable Common Tool Environment (PCTE) is a set of software services required to build IPSEs. These services support the integration and portability of tools. A good introduction to the concepts of PCTE is given in [1].

PCTE '91 showed that PCTE is gaining wide acceptance. This was not only illustrated by the large number of attendants (about 160 from 16 countries in Europe, North America and Asia), but also by announcements made by several major platform suppliers (Digital, HP and IBM). Furthermore, a large number of CASE tool vendors discussed the use they are, or will be, making of PCTE. The conference lasted three days, each day was targeted at a different audience. The first day was targeted at decision makers, the second at application builders, and the third at tool builders.

This report contains an account of the presentations given at the conference. This account is based on the speakers' overhead sheet presentations and the authors' personal notes. Copies of the overhead sheets were handed out at the conference. Each chapter of this report contains the presentations of a particular day. Attached to this report are three appendices. The first appendix contains the actual program of the conference, the second appendix lists the attendants actually present at the conference. The last appendix contains the full text of the conference opening address.

[1] CASE = Computer Aided Software Engineering

2 DECISION-MAKERS' DAY, WEDNESDAY 25 SEPTEMBER 1991

On the first day of the conference, the Decision-Makers' Day, the conference was opened by Mr Spohr, Director of TNO-FEL. The organisations involved in PCTE presented their motivations to support PCTE-related programmes. During the session on Industrial PCTE Strategy, major platform suppliers revealed their PCTE strategy. Several of the speakers of this day participated in the panel. The Decision-Maker's Day was concluded by a management introduction to PCTE.

2.1 Opening Address

Speaker: Mr P. Spohr

PCTE '91 was opened by Mr Spohr, Director of TNO-FEL. In the opening address he distinguished three kinds of open systems: Proprietary (P type), De facto (D type) and Standardized (S type). PCTE clearly is an S type of open system. Apart from the advantages that open systems can offer a tool user, Mr Spohr also identified several (sometimes forgotten) advantages open systems can offer a tool supplier: less risk at product introduction, a larger initial market, and stability of that market. He concluded his talk by stating the user requirements that emerged from a discussion about the introduction of a standard CASE tool at TNO-FEL. The requirements were: portability of tools, similarity of user interfaces, support for different methods, interoperability of tools, and support for teams.

The complete text of the opening address is attached to this report as Appendix C.

2.2 Organizations behind PCTE

2.2.1 PCTE Standardization

Speaker: Mr Myer Morron

Mr Morron (BNR Europe Ltd), the chairman of ECMA TC33, gave an overview of past, present and future of PCTE standardization. Furthermore, he gave a personal view of the positive achievements as well as some negative aspects of ECMA TC33. He concluded his talk by pointing out that currently, PCTE is really entering the exploitation phase.

Mr Morron divided the evolution of PCTE into four periods. During the first period, 1983-1986, the concepts underlying PCTE were developed in the CEC Esprit project 32. This project led to the PCTE 1.4 C Specifications. During the next period, 1986-1988, the applicability of PCTE was broadened in the IEPG TA-13 programme. Within this programme PCTE+ Issue 3 was developed, which was based on the PCTE 1.5 Ada and C bindings developed under the auspices of the PIMB. During the next period, 1988-1991, PCTE was standardized by the ECMA. Until now the Abstract Specification, ECMA 149, as well as the C language binding, ECMA 158, have

been standardized by ECMA. In the near future an Ada binding (December 1991)[2] and a C++ binding (June 1992) will be standardized. However, the date for the C++ binding is rather optimistic. One of the major problems in the development of this standard is the absence of a C++ language standard. The last period in PCTE evolution, which started in 1991, must lead to international standardization in ISO. Depending on support within ISO the fast track will be followed. However, no risk will be taken in order to prevent any possibility of rejection, since this would devalue PCTE.

Mr Morron thought the TC33 programme had achieved several positive points. It produced several high-quality standards and carried Open Systems to higher levels. Within the programme natural conflicts in members' business interests were overcome. Moreover, good personal, business, and technical relationships were created. The programme established European R&D in Software Engineering Standards and brought together Civil and Defence interests as well as Government and Industry interests. On the negative side, Mr Morron experienced that it was very difficult to get enough resources for the work. He stressed that it was important to have a strong team in place to carry work forward via ISO. Furthermore, he regretted that there was still no good introduction to ECMA PCTE available.

Mr Morron concluded his talk with pointing out that PCTE is really coming entering exploitation phase:

- PCTE is supported by all major platform suppliers (IBM, DEC, H-P, Sun, and Bull);
- many toolsets are under development (EAST, Enterprise II, HyperWeb, and Concerto);
- major tool suppliers are interested or active in PCTE, (CADRE, IDE, MARK V, and MENTOR);
- PCTE is considerably influencing US DoD activities (AJPO, STARS, and PCIS).

In this respect, Mr Morron found the recent announcement of the US Department of Commerce - National Institute of Standards and Technology (NIST) very important. On 3 September 1991 it was announced that NIST proposes to use the ECMA PCTE specification as the basis for the development of an integrated set of ISEE PTI[3] standards. According to Mr Morron, this announcement will have a great impact on the availability of PCTE from US developers.

2.2.2 Why PCTE for Defence?

Speaker: Dr Brain Gladman

Mr Gladman (MoD UK), chairman of IEPG TA-13, described the rationale behind the IEPG TA-13 programme and the work undertaken. Mr Gladman pointed out that many defence systems now depend on computers and hence software. However, software intensive defence projects frequently run into difficulties. Since software engineering is at present still an immature discipline, investment in technology assessment and demonstration is needed.

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[2]The Ada language binding for PCTE was accepted as an ECMA standard (ECMA 169) by the General Assembly of December 1991

[3]ISEE = Integrated Software Engineering Environment

PTI = Public Tool Interface

Because high capability software tools are very costly to develop, the investment needed can only be sustained by a large market. A common tool interface is a way of generating such a large market. PCTE was selected as common tool interface, since a civil, international standard was thought to be essential to obtain the benefit of a large commercial market. Furthermore, the standard had to be a non-proprietary 'open' standard. The selected common tool interface had to be capable of supporting all defence software engineering needs. Therefore, some improvements were needed in PCTE, notably with respect to security, independence of operating system, and programming language. A defence project was set up by the Independent Programme Group Technical Area 13 to extend PCTE and assess the result.

Within the IEPG TA-13 programme ten European countries participate : Belgium, France, Germany, Greece, Italy, the Netherlands, Spain, Turkey, and the United Kingdom. The PCTE+ project is scheduled to complete at the end of 1992. To date the PCTE+ requirements have been established and the PCTE+ standard has been defined. Within the programme PCTE+ implementations on two different host operating systems (UNIX, VMS) will be made and a range of tools will be developed or ported onto PCTE+.

Since ECMA PCTE fully meets the PCTE+ requirements, there now is an international public interface standard, supporting defence software engineering needs.

2.2.3 PCTE is the Open Repository

Speaker: Mr Robert Cochran

Mr Cochran (Catalyst Software), chairman of the PCTE Promotion Group, described the work of the PCTE Interface Management Board (PIMB) as well as that of the PCTE Promotion Group (PPG). The PIMB has been mainly involved in building the PCTE community, the PPG is promoting the PCTE take-up.

In 1986, at the end of the PCTE ESPRIT project 32, the PIMB was created. Its main role has been to focus and coordinate PCTE activity, thus building a PCTE community. The key milestones reached by PIMB are: the preparation of PCTE 1.5, the sponsoring of ECMA TC33, the creation of the PCTE Newsletter, and the establishment of the PCTE Promotion Group. The PIMB forms an international PCTE forum. All major platform vendors, the relevant international groups, and representatives from software industry are participating in the PIMB. Furthermore, there is a rapidly growing interest in the PIMB from tool and toolset vendors. Early this year the Terms of Reference of the PIMB were changed radically: the PIMB is now open to all interested organizations.

The PPG, established in March 1990, is a standing committee of the PIMB. It consists of companies commercially committed to PCTE. However, the PPG does not promote PCTE products; it promotes the PCTE concepts. The PPG members jointly pay for the promotional expenses. In addition to this, the PPG gets support from the CEC.

The PPG played an important consultative role between competitors, thereby creating a common market understanding. It also coordinated attendance at exhibitions. For instance, there will be a PCTE section at the Toulouse conference in December this year. Furthermore, the PPG is planning the institution of a North American PCTE Group.

Mr Cochran stressed that the goal of PIMB and PPG is to promote PCTE as the de-facto standard in dominant use. Worthy of A chairman of a promotional group, Mr Cochran ended his talk with some slogans:

PCTE is now the standard Open Repository.
PCTE is here,
is in use,
is endorsed,
is available,
is controlled.

We might add PCTE is here to stay.

2.2.4 PCTE and CEC

Speaker: Mr David Talbot

Since the CEC is a long term investor in PCTE, Mr Talbot gave an investor's viewpoint of PCTE. Mr Talbot estimated that to date more than $100 million was invested in PCTE by the CEC, the commercial partners and the military. Mr Talbot first sketched the background motivations for the CEC to embark on the PCTE related projects, then gave the current position. He concluded his talk by identifying some future needs.

According to Mr Talbot, the background motivations of the CEC for starting the PCTE project are a mix of facts and beliefs. It is a fact that software becomes the dominant cost and major part of the added value of computer systems. So, there is a common belief that technology support for life cycle of software intensive systems is critical. There is, however, no quantified result to support this belief. To provide full life cycle support, individual CASE tools are not enough; they need to be integrated. However, the CASE methods/tools market is still relatively small and immature. Therefore, it is believed that an 'integration framework' is needed, forming a basis for improving market for both users and suppliers. Such a framework reduces the risk and investment for vendors and provides the users with a better choice.

To fill this need for an integration framework, the CEC initiated several technology projects within Esprit. Not only projects supporting the development of a pre-normative standard for an open, portable common tool environment, but also prototype projects and validation experiments were set up. Examples of these ESPRIT projects are PCTE (the 'base project'), PACT ('tools project') and ATMOSPHERE ('systems project'). To support the open and public evolution of the standard the PIMB was established.

Mr Talbot concluded his talk by identifying future needs. His conclusion was that technology issues are currently 'second order'. Non-technology issues are of major importance. Some of these issues are:

- confidence in supply,
- back-up capabilities,
- choice of implementation, and
- easy of buying.

2.3 Industrial PCTE Strategy

2.3.1 Digital's PCTE strategy

Speaker: Mr Luciano Vernocchi

Mr Vernocchi, Digital Equipment Co., expressed Digital's commitment to standards in general and to PCTE in particular. He sketched the COHESION strategy and the advantages obtained by incorporating PCTE within the COHESION environment.

Digital is strongly committed to standards. Existing standards are accommodated in solutions for customers' business problems where appropriate. These standards are adopted while protecting customers' investment. Digital also contributes to the definition of new standards and to the evolution and convergence of existing ones.

In accordance with their commitment to standards, Digital contributed to ECMA-PCTE standardization and contracted Emeraude to port PCTE V12 to Digital's RISC systems. In 1988 an internal research project was started to demonstrate that PCTE and ATIS can be merged into a single implementation supporting both interfaces. Furthermore, a technical architecture was identified which enables the inclusion of PCTE in Digital's COHESION environment.

COHESION supports application development and deployment for multi-vendor, integrated and distributed systems. COHESION is designed to accommodate, as key components, new relevant CASE standards such as PCTE and ATIS. It has a 'plugable', evolvable and flexible architecture based on three levels of integration: presentation, control and data. Presentation integration, giving a common look and feel tailored to CASE work, is provided using Motif (OSF).

Control integration is provided by the use of the Application Control Architecture Services (ACAS). ACAS are proposed by the Object Management Group. They provide facilities to locate, launch and connect applications in a distributed, heterogeneous environment. Object-oriented technology is used to register applications and their services.

Data integration is obtained by the use of Data Servers, which are applications registered in ACAS. These servers provide a single, uniform interface for tools to access different repositories. They provide services for management of data, versions, and configurations. Currently targeted repositories are CDD/Repository (ATIS) and PCTE.

Integration of PCTE within the COHESION environment as a repository, enables COHESION tools to access PCTE OMS services through a Data Server (or a Repository Server). The PCTE tools integrate with ACAS to interoperate with 'foreign' COHESION tools and other PCTE tools. Furthermore, PCTE tools can directly access OMS services.

Digital's policy to integrate PCTE within COHESION offers several strategic advantages:

- it provides distributed and flexible control integration services to PCTE based on the OMG standard;
- it provides Multi-Repository, Multi-Framework portability that increases capabilities for Digital's customers;
- it enables a consistent Software Development Environment for PCTE and non-PCTE based frameworks;
- it facilitates migration from existing distributed SEE to PCTE distributed SEE; and
- it supports framework convergence activities that enhance overall functionality and minimize associated business risks for tool vendors and customers.

2.3.2 Hewlett Packard's PCTE plans

Speaker: Mr George Tatge

HP is involved in two CASE businesses: frameworks and environments. It delivers the SoftBench framework and licenses its technology to others, and delivers C and C++ software engineering environments built on SoftBench.

HP endorses the use of ECMA PCTE as the open repository standard for CASE frameworks. The Data and Control Integration components of the ECMA/NIST Reference Model will be PCTE and SoftBench. HP plans to implement the Control Integration standard on PCTE. To identify the requirements for this implementation major customers and vendors will be consulted. Projects for this development are now being staffed at Fort Collins, a product division, and Bristol. HP will continue to work with major customers and vendors to standardize CASE frameworks.

2.3.3 Industrial PCTE policy

Speaker: Mr Phil Thornley

Mr Thornley, British Aerospace (Military Aircraft) Ltd, sketched the experience gathered in procuring the EuroFighter IPSE. Based on this experience the AIMS project was started. He concluded with the Aerospace Requirements for an IPSE.

The partners in the EuroFighter development (Alenia, BAe, CASA and MBB) agreed that an IPSE was required to develop the many embedded computer systems onboard of the aircraft. It took about five years from the initial discussion on requirements for this IPSE to its delivery. To shorten this time in the future more use will be made of 'off-the-shelf' products. Therefore, a competitive supply of environments is needed.

AIMS is an industrial research project. The application domain is embedded computer systems (ECS) development and maintenance. The strategic objectives of the AIMS project are:

- to improve the productivity of ECS development,
- to stabilize time schedules of ECS development,
- to provide for the effective cooperation of the European Aerospace Industry, and
- to improve distinctly ECS quality.

The AIMS project consists of two phases: a definition phase and a demonstration phase. In the first phase an ECS development model, the problem identification and analysis, and an evaluation approach were produced. In the second phase particular solutions will be evaluated using the agreed evaluation approach in demonstration projects. This will produce evaluations of the solutions as well as of the evaluation approach itself. Furthermore, the fundamental features of architectures for environments will be defined. The work will be undertaken based on the following strategy:

1) use what is already available;
2) influence current development work;
3) carry out essential work where necessary.

In accordance with this strategy, Mr Thornley participated in both PCIS workshops and in the PCIS expert team meeting. Mr Thornley observed that PTI programmes are starting to address real user needs, for instance evolution. The AIMS project will put forward to PCIS a detailed statements of requirements.

Mr Thornley concluded by indicating two major aerospace requirements: support for traceability and long term support. To support traceability between development phases, fine grain data integration is needed. Only the PTI mechanism should be used for this integration. Within the Aerospace industry products have lifetimes over 40 years. So, there is a definite need for long term support. Therefore, it must be possible to update the environment technology while keeping full access to the data.

2.3.4 IBM OPEN ENTERPRISE AD Strategy and PCTE

Speaker: Mr Germain Sagols

Mr Sagols of IBM outlined OPEN ENTERPRISE Application Development and its relation to PCTE. IBM supports the standardization efforts for open systems in general and PCTE in particular. Mr Sagols illustrated IBM's commitment to open systems with two quotations. The second quotation explicitly mentioned PCTE : "... extensibility to accept open enterprise industry standards as they emerge, in particular ECMA PCTE..." (Open Enterprise AD Announcement of September 11th 1991).

Within OPEN ENTERPRISE Application Development two types of platforms can be distinguished: IBM AD/Cycle and IBM AIX/CASE. IBM AD/Cycle is used on an enterprise level for application areas like finance, insurance, transportation, public sector and MIS shops.

Standards for these platforms are IBM SAA, IBM API, and IBM CPI. IBM AIX/CASE platforms are used on a departmental level for application areas like aerospace, engineering, military, and telecom. Standards for these platforms are: Unix System V.2, Unix BSD 4.3, OSF/Motif, POSIX IEEE 1003.1, and ECMA PCTE 149. The reference model for AIX/CASE is based on the ECMA CASE Reference Model.

Both PCTE and AD/Cycle are responses to customer demands for data integration workbenches. In 1991 one PCTE workbench, EAST, became available on the RISC System/6000. Other workbenches, CONCERTO and ENTERPRISE II, will become available in 1992. These workbenches, offering data integration, are based on Emeraude's V12 PCTE implementation.

Tool data integration has several benefits. Since the data is unique, it offers high reliability. Responses to change are easy, since it provides full traceability. It is easy to reuse components, thereby increasing productivity. The mix of product and process data enables to achieve a high quality.

2.4 The Software Technology for Adaptable, Reliable Systems (STARS) and PCTE

Speaker: Dr John Kramer

Mr Kramer, DARPA/SISTO gave an overview of the context and status of the STARS program. After that, he discussed the relationship between this program and PCTE. He concluded by inviting parties to participate in the STARS program.

The STARS program is part of the DARPA software plan. The mission of DARPA is to create a breakthrough in the technology for DoD missions. Within the DARPA program there is a major, increasing emphasis on information technology. The DARPA software plan is organized around the strategic themes megaprogramming and infrastructure/maturity model. This plan is developed in concert with wider DoD plans, like the DoD Software Master Plan and the DoD Software Technology Plan. The mission of the STARS program is to meet the charter goals of reducing DoD software costs and increasing quality. Furthermore, it has to accelerate the shift to a process-driven paradigm within the DoD software-intensive system development and maintenance community. The paradigm shift should support collaborative development across geographically dispersed project teams.

Influenced by the mission and reuse objectives, domain assets are developed. These assets are process definitions, domain architectures and components. By tailoring the domain assets to a particular application, an application adapted software engineering environment (SEE) is developed. Such an environment contains development tools, life-cycle process support, and an asset library. The SEE objectives of the STARS program are:

- to demonstrate the benefits of a framework-based approach to instantiation of software engineering environments (SEEs);

- to reduce adoption risks inherent in integrating and utilizing new technologies;
- to ensure that the basic infrastructure is available to support
  process management and control,
  reuse libraries and support mechanisms, and
  tool interoperability and integration.

Within STARS standards are selected using the following criteria (in priority order):

1. relation to problem domain,
2. coverage of requirements (engineering),
3. STARS prime concurrence (marketplace),
4. availability of products within STARS timeframe,
5. maturity - standards spectrum of international, national, de-facto (stability).

STARS develops no standards, but acts as a neutral territory for tool vendors, framework providers, and standard groups. STARS role is to focus attention and to disseminate information. Within STARS several standards are agreed upon by all primes, e.g. POSIX, X-Windows/Motif. However, STARS has not selected a standard for OMS. The two main candidates, CIS ATIS and ECMA PCTE, are relatively immature. Both are primarily test vehicles for OMS technology. Moreover, the operational experience with either is limited. As on-going activity within STARS use is made of a framework-based SEE test-bed to explore interoperability and evaluate integration issues. Furthermore, 'right' versus 'wrong' standards profile are identified. The commercial counterparts within STARS are actively involved in this. STARS provides a neutral ground for industry-wide profile discussions. The STARS profile will be used on three instances. These instanceswill be performed by Boeing, IBM (FDS), and Unisys Defense Systems, Inc.

Boeing established an alliance with DEC to have early access to new products, to feed 'real' requirements to DEC, and to have long-term product support. Furthermore, Boeing wanted to utilize DEC Cohesion and open interface standards. Boeing will build a SEE in order to demonstrate data integration, a process-controlled environment, reuse and reuse tools integral to the process, and integration of systems and software engineering. Boeing will incrementally incorporate process and reuse technologies.

IBM Federal Systems Development will utilize commercial off-the-shelf products, since many components are now available. Their SEE will stay compliant with open systems standards like POSIX, X/Motif and PCTE. It will be configured as solution sets capable of supporting 'unique' DoD requirements.

Unisys Defense Systems, Inc, will also use commercial off-the-shelf products, namely Emeraude PCTE, Enterprise II, and Software through pictures. It will evolve and integrate Unisys tools (like READS, RLF Reuse Library) on open frameworks. Other capabilities will be integrated, e.g. Arcadia metrics collection and process mechanisms.

2.5 Panel: "Technology Push, Smart Buyers, and Market Pull. The Forces Accelerating PCTE?"

Chairman: Mr van Hoek

Mr van Hoek, Director Defence Research and Development, Netherlands Ministry of Defence, first introduced the panel members:

Mr Ian G. Campbell, Emeraude
Mr Myer W. Morron, ECMA TC33
Mr John F. Kramer, DARPA
Mr Germain Sagols, IBM
Mr David Talbot, CEC
Mr George Tatge, HP
Mr Luciano Vernocchi, Digital

During the introduction of the panel members by Mr van Hoek, it was revealed that a commercial PCTE implementation might become available from India. Heuristix Ltd based the implementation of their repository on the ECMA PCTE specification. They will probably bring out a full implementation of ECMA PCTE. Currently there are two commercial PCTE implementations available, one from Emeraude, which is already sometime on the market, and one from Verilog. After his introduction Mr van Hoek invited the conference participants to ask questions.

Q. J. Solomond, AJPO: Europe invested 500 manyears in PCTE, was this totally from the CEC? Is some of the enthusiasm for PCTE not based on the investment to date?

A. Morron: It is difficult to give an accurate estimate, since there were many peripheral projects. Anyway, the investment must be 500 to 1000 manyears, including industrial investment. This amounts over $100 M ($50 M for CEC). Enthusiasm for PCTE is not based on money spent, but on belief in PCTE.

A. Campbell: This amount does not include all investments, e.g. the investment in French projects. I cannot be enthusiastic about just investing money. However, it was not at all a bad idea to invest in PCTE.

Q. Unknown: Is STARS a defence-related mixture of civil and defence spending? Over a period of time defence spending will decrease more and more. The key issue is to use leverage to make sure that developments meet your own wishes.

A. Kramer: We must realize that defence will be just a small amount of the market place. STARS is building on COTS. The DoD should not spend a lot of money on technology. If the STARS demonstrations fail, the suppliers will have failed. They have let me prove that they can not do the job.

A. Tatge: It does not make much difference where the money is from. A good sign for us is that companies are taking advantage of things put into the public domain. Also, the US involvement is encouraging.

A. Vernocchi: It is difficult for us to promote a European standard in the US. The basic support for this came from the US defence industry. So, they took the lead in these developments. Europe was good in setting up and defining PCTE. The US is trying to work out a convergence.
A. Sagols: The frontier between defence and civil applications is disappearing.

Q. N. Wybolt, Cadre: How can tool providers be blamed, if they do not own the enabling technology?
A. Kramer: Take it as a challenge. If I have to spend 90% of my money on integrating Cadre, then two companies have failed: Cadre and the platform provider.

Q. T. Oren, University of Ottawa: Did PCTE carry Open Systems to higher levels?
A. Morron: First there used to be a lot of discussion on hardware level standardization, then on operating systems (Unix, Posix). Manufacturing companies spent most of their money on operating systems. Currently, there is some agreement on Unix/OSI. It is becoming part of the plumbing. (PCTE originated as a Unix extension for SEE.) I would like to see PTIs to become part of the plumbing too. It is time to move to higher levels: standard schema libraries, interface formats, etc.

Q. N. Wybolt, Cadre: Is there any work performed on migration guides for tool builders by the platform suppliers?
A. Campbell: Several environment suppliers are keen to tell tool suppliers how they can integrate their tools. Most offer tools supporting an initial loose integration, which can be tightened later on. You should make the experience gained available to people interested. Furthermore, you should get advice from the environment supplier how to cater for evolution.
A. Tatge: Look at how we developed SoftBench.

Q. N. Wybolt, Cadre: Broadcast integration like in SoftBench is easy. We like to change the schemas. Integration guides will provide support for assessing migration costs. Will integration guides become available?
A. Vernocchi: PPG also recognizes the need for integration guides. Today you can encapsulate a tool, but this doesn't solve integration yet.
A. Sagols: This is the domain of the tool builder, not of the end user. PCTE technology is difficult to understand. For integration the next step will be a standardized data model.

Q. E. André, SEMA: Will platform suppliers provide proprietary implementations for free, like they do with X11?
A. Campbell: It is a mistake that you get such an item for free: it is bundled as part of the operating system. When PCTE is part of the plumbing, it should be bundled.

Q. I. Thomas: What are major impediments for
- widespread use;
- acceptance and success on a world-wide basis;
- a commercially successful business?

A. Gladman: We are at the end of the beginning. The big question is now whether the standard will become a true multi-vendor standard. So, the key issue is investment form industry. However, we have to consider that going from concept to reality takes a decade.

A. Morron: My company, BNR is a potential user. ECMA PCTE meets long term requirements for a repository. However, it is absolutely important to have different implementations, probably for different kinds of application domains. The neutral aspects of the standards can be implemented differently.

A. Roach, Digital: This question on impediments was asked during a basic customer research carried out by us. The biggest impediment appeared to be that we as vendors/standardization bodies have failed to show customers what return on investment there will be. Technological impediments were not mentioned at all.

A. Campbell: Most buyers are hesitant. We are also moving into MIS market and the telecommunications market. I am optimistic: within five years we do not need to discuss this issue anymore.

Q. D. Longden, UK MoD: We have implementations of PCTE 1.5, not of ECMA PCTE. When will ECMA PCTE implementations become available?

A. Campbell: We have plans to produce ECMA PCTE implementations.

A. Vernocchi: Using different names caused a major confusion in the market. This was wrong from a marketing point of view. Most manufacturers have intentions to produce PCTE.

Q. H. Davis, ICL: There is a need to get the tool suppliers together and talk how to handle this technology. In North America there is a initiative for a PCTE users group. Is there also something going on in Europe?

A. Cochran: The PIMB is changing into such a group. Maybe later on there will be a separate users group. At the Esprit Technical week this point was discussed. The conclusion was that forming such a group is not necessary at this time.

Q. B.P. Bhat, Heuristix: As a repository supplier we are interested in the certification of our products. Are there any mechanisms for this?

A. Talbot: Currently there are no certification mechanisms for PCTE. But in the EEC (as well as in the US) mechanisms for certification are being developed. As soon as the market place asks for them, they will become available.

Q. Demiame, CRIN: The number of tool interfaces we need is small (one or two). The number of interface implementations will also be small (two digits, about twenty). However, the number of environments will be large (three digits). Success of PCTE will be expressed in the availability of environments. Outside PCTE a lot of technological issues have to be solved, like integration and common data schemas.

A. Gladman: It will take about five years to get PCTE firmly embedded.

A. Talbot: The issue is not whether PCTE is successful, but whether software engineering (SE) is.

Do people take software serious
Do people take software production serious
Do people think SE contributes to software production
Do people believe PCTE contributes to SE

Again, the important issue is to get evidence for return on investment. We should do this before spending more money on technology.

Mr van Hoek rounded off the discussion by stating that there is no doubt whether PCTE exists. However, that is no reason to sit back and be satisfied.

2.6 A Management Introduction to PCTE

Speaker: Mr Ian Campbell

The Decision-Makers' Day was concluded by a management introduction to PCTE given by Mr Campbell of Emeraude. This gave him the opportunity to use the promotional slides produced by the PPG.

According to Mr Campbell software plays a crucial role in business success. It is used, for instance, for office automation and in communication systems. Nowadays, the profitability of business relies on software capabilities. Therefore, the quality of software may become (and is often) a limiting factor in economic growth. It affects operations such as manufacturing and decision making. For this reason software engineering should not be treated as just a technique; it is a corporate resource.

However, software production cannot match the increasing needs. This is illustrated by the fact that currently the large majority of software development companies still finds itself at the lowest level of the software process maturity model. This maturity model, developed at the Software Engineering Institute of the Carnegie Mellon University, distinguishes five levels of process maturity: initial 'handcrafted', repeatable, defined, managed and fully engineered. A key challenge is associated with each level. The key challenge of level four, a managed process, is to get appropriate CASE tools integrated in a Software Engineering Environment (SEE).

A basic SEE consists of many tools, which are not integrated. By sharing data, the tools can be integrated into a repository based SEE. A well-known model for SEEs is the Open SEE Reference Model of NIST/ECMA. In this model the services needed for the integration of tools in a SEE are identified. The services are for: data repository, data integration, task management, user interface, and message server. These services must rely on Open Standards.

In the area of software engineering there are several open standards, for instance, for portable operating systems (POSIX), portable languages (ANSI: Ada, C, Cobol, Fortran), portable user interfaces (X-Windows, OSF/Motif). However, the keystone of software engineering success is an Open Repository based on open public standards. The only available portable open repository today is PCTE, the Portable Common Tool Environment. It is a public standard and provides a solution for Open Systems.

The global characteristics of PCTE, the Open Repository, are:

- data distribution across a network (real distribution),
- data base consistency and integrity control (transactions),
- security (access control, concurrency synchronization), and
- modularity, on-line modification of data models.

All these characteristics provide Quality Support for the Software Development Process.

3 APPLICATION-BUILDERS' DAY, THURSDAY 26 SEPTEMBER 1991

On the Application Builders' Day, the second day of the conference, several environment builders described how they extended the capabilities of PCTE to satisfy several important user needs, e.g. customizibility and traceability. They also indicated the lessons learned on the usability of PCTE. Furthermore, there were some more general talks on CDIF, PCTE training, and comparing current repository offerings.

3.1 To build an Environment on top of PCTE

Speaker: Prof. Derniame

Prof. Derniame of the University of Nancy described how the users' need to tailor software engineering environments is satisfied by ALF (Accueil de Logiciel Futur - see [5] for more on ALF). In the ALF Esprit I project an environment framework has been built on top of Emeraude's PCTE implementation. This framework can be customized using a MASP (Models for Assisted Software Processes) resulting in an ALF-based IPSE.

The aim of ALF is to provide customizable environments which allow people to define their jobs in terms of:

- the tools they will use;
- the order that they will do things;
- the permissions and degrees of freedom they will have to work in;
- the schedules they must keep to.

Within ALF, this goal is achieved by providing process modeling capabilities.

A software process is a set of engineering activities for transforming users' requirements into a running software system and for maintaining it. This process encompasses both technical and managerial concerns. Within ALF the MASP concept provides a formalism to describe various software process models in a uniform way. By instantiating this MASP, using an Instantiated MASP (IMASP), a project-specific process description is derived. Execution of an IMASP by ALF results in an Assisted Software Process (ASP).

In the ALF project, an ALF system and a Framework for ALF-based IPSEs are built. The ALF system supports the modelling of the software process resulting in the construction of a MASP. By plugging the MASP into the framework, an ALF-based IPSE is obtained.

3.2 Meeting User Requirements for Control in a Large Scale IPSE

Speaker: Mr Martin Kirby

Mr Kirby of SD-Scicon demonstrated how the main user requirements (authority, stability, and reliability) for the EuroFighter Aircraft (EFA) IPSE could easily be met by PCTE.

In the EFA IPSE there are four different authority entities: users, domains, tasks, and commands. The users can be modelled as PCTE user objects, domain and tasks as user groups, and commands as program groups. The stability requirements can be met by placing stabilizing links to make public data immutable. Navigation restrictions give a stable domain name space. Reference links protect data in use from deletion. To achieve reliability, transactions can be used for atomic updates. Program groups and usage modes can realize non-falsifiable accolades.

According to Mr Kirby, the management conditions of the EFA IPSE map directly to PCTE facilities. Use of these facilities makes the tools independent of management conditions. So it is not necessary that tools call other tools or interfere with life-cycle tools. The knowledge about the management method does not have to be incorporated in the tools.

A participant at the conference summarized the keypoint of Mr Kirby's case as follows: major user requirements can easily be met by tool providers by building tools on top of PCTE; therefore, procurement of an IPSE will not take as long (five years) as it took to procure the Eurofighter IPSE.

3.3 Building an IPSE on top of PCTE

Speaker: Mr Bourguignon

Mr Bourguignon of SFGL described the lessons learned in the Eureka EAST project. The EAST project aims at implementing and marketing a Software Engineering Environment that is adaptable to the users' needs and is easy to use. EAST is based on Emeraude V12 and fully exploits the PCTE functionalities.

Based on three years of industrial PCTE use, Mr Bourguignon concludes that PCTE can be used in two ways: for tool integration and for information system modelling. Tool integration is a means to master the complexity of developing software engineering tools. Information systems modelling is a means to master the complexity of projects.

Tool integration facilitates the optimization of development costs. Tools can be easily integrated in an Open Environment that provides data evolution and tool encapsulation. Within EAST data evolution is supported by the SDS and Working Schema concepts of PCTE. To integrate a third party tool into EAST, it is encapsulated. This encapsulation provides an interface with the PCTE OMS for data integration, and an interface with the EAST User Interface Management System for presentation integration. Presentation integration is only complete for batch tools.

To master the complexity of projects, the development process must be modelled. PCTE allows to model data manipulated by any actor and to model any process. In this way, an information system dedicated to software development can be constructed. This information system supports strategic, management and operational activities. By enriching the information, the increase in complexity may be mastered. This enrichment is enabled by the evolutivity of the PCTE Data

Model. To enable the users to enrich their own information system, the data schemas of the tools shall be published and some shall be standardized.

3.4 Object Granularity in the Concerto Repository

Speaker: Mr André

Mr André of Sema Group addressed the problem of grain size in SE environments and the solutions provided in the Concerto environment. He argued that fine grained objects are necessary to support traceability. However, using fine grained objects could lead to performance degradation.

Within the Concerto environment the problem of grain size has been solved by providing a generic repository interface. This generic interface is built on top of each specific repository. In this way a clear distinction is made between logical organization and physical implementation. The way a specific object type is implemented and cached is left to the experts in the corresponding domain. Efficiency can be obtained by relying on the structuring concepts for that particular type.

According to Mr André, the Concerto architectural model does not conflict with the PCTE Object Management System. It provides progressive integration and proposes migration paths. However, the PCTE implementation has to address the problem of grain size.

3.5 The CASE Data Interchange Format (CDIF) Standards

Speaker: Mr Mike Imber

Mr Imber of LBMS described the CASE Data Interchange Format (CDIF) standards and their relation to PCTE. The objective of CDIF is to facilitate exchange of information between CASE tools. This is achieved by providing a single interchange format for use between CASE tools. This requires definition of the meaning (the semantics) of information transferred, and of the transfer format.

To define the semantics and the format of information transferred a four-layer architecture is used. The first layer of this architecture is the Data Layer, consisting of the instances of objects in the tool's model. The second layer is the Model Layer, consisting of the CDIF Models, the actual information, transferred between tools. The third layer, the Meta-model layer, consists of CDIF models for CASE. A Meta-model is split up into two models: a semantic model, defining the semantic aspects of models transferred, and a presentation model, defining the graphical representation of models transferred. The last layer, the Meta-meta-model Layer, gives rules for building CDIF Meta-models.

The CDIF standards will be initially used to define models for tools in the "Upper-CASE" area, since this area is best understood due to widespread usage. This choice will enable CDIF to be used by greatest number of tools with initial coverage.

Users benefit from CDIF by being able to select the most appropriate tools for each stage of the development process. It enables them to transfer information between tools without having to rekey it and enables them to avoid tool versioning problems. In this way the investment of users in CASE tools is protected. Vendors benefit from CDIF by being able to satisfy the users' request for interfaces in a generic manner with a single interface, thereby avoiding maintenance and investment problems inherent in the provision of multiple interfaces.

CDIF can be used for the interchange of information between PCTE databases or between a PCTE database and another environment. The CDIF standards also provide a means to define standard SDSs to enable tool communication. Using the CDIF standards for PCTE is an assessment of the modelling capabilities underlying these standards: "Can CDIF express the capabilities of PCTE, like distinct SDSs, shared objects, and link types?" (See [8] for further information on PCTE and CDIF).

3.6 ToolBuider and the Open Repository

Speaker: Mr Paul Harris

Mr Harris of IPSYS Software Plc. first outlined the differences between first and second generation CASE. Then he discussed meta CASE tools. He concluded with a discussion of repositories.

The first generation of CASE tools consisted of "simple", single purpose tools. These tools could not be configured or integrated. They were mostly built to provide a short term solution. The second generation CASE tools consists of tailored, configurable life cycle tools. They support methods which are suited for a particular organization. These tools provide a strategic, long-term solution.

Second generation CASE tools are introduced in an organization using a top-down approach, consisting of three stages. In the first stage the software process and quality assurance models are identified, resulting in a description of the organization's own method. In the second stage the repository strategy is defined and the tools needed to support the method and strategy are identified. It is likely that there is a need for meta CASE tools. In the last stage the software process and quality assurance is automated.

IPSYS' ToolBuider is a meta-CASE tool, a CASE-tool generator. Central to this ToolBuider is IPSYS' repository technology, which is naturally ERA and PCTE compliant. To solve granularity problems it has a two-tier data model: the first tier is for coarse grain data, the second tier for fine grain data.

3.7 Implementation of a Complex Software Development Environment - EPOS in a PCTE+ Environment

Speaker: Mr Rau

Mr Rau of GPP described the EPOS (Engineering and Project Management Oriented Specification) environment. EPOS is an IPSE supporting development as well as reverse engineering. It is a proven product interfacing with many other tools of different manufacturers. However, it has a dedicated repository, dedicated user interface, and is dependent on the data security/integrity of the underlying operating system.

Within GPP a strategic decision has been taken to use PCTE in order to improve standardization and user acceptance. The PCTE Object Management System will be used for data integration and OSF/Motif for user interface integration. Control integration will partly be achieved using PCTE access control functions.

According to Mr Rau, PCTE offers a variety of promising features that are of interest to software tool manufacturers, e.g., a common repository, data security functions, and data exchange mechanisms. However, the question of semantical data exchange between tools is still an open issue.

The first version of the PCTE port of EPOS will be built on Emeraude's PCTE+ prototype implementation. The release to customers is expected at the end of 1992. Several purchase options have already been placed.

3.8 PCTE Training - Experiences of UCW Aberystwyth

Speaker: Dr Mark Ratcliffe

Mr Ratcliffe of the University College of Wales at Aberystwyth described the contents of the PCTE course given at his university. The emphasis of the course is on gaining practical experience. During the course the TIPSE (Teaching IPSE) built on top of PCTE is used. TIPSE provides a fully integrated environment for teaching software engineering. It is an ideal training environment for PCTE. To emphasize the benefits PCTE gives, TIPSE does not hide PCTE from its user.

3.9 The HyperWeb Project

Speaker: Dr Gérard Memmi

The HyperWeb technology, described by Mr Memmi of Bull, is based on the observation that software is a composite; it is more than code, more than text. Software is a complex "web" of all kinds of information. This information can be efficiently accessed using the hypertext capability of HyperWeb offered by special editing tools.

In the architecture of HyperWeb three layers can be identified: the editing tools, the HyperWeb server, and the OMS server and its common services. The editing tools make up the user interface: the Outline Web Editor, the Link Editor, and the Node Creator. The HyperWeb server is the kernel of HyperWeb. It consists of three parts: a scripting language, a communication protocol, and an interface to PCTE. The scripting language enables a user to customize the HyperWeb environment. Each instance of the HyperWeb server is dedicated to one user. The OMS server on the other hand manages the data for all users. Configuration management and query facilities have been added to the OMS as common services. Configuration management has been built using the Version Management Common Service (VMCS) provided by Emeraude V12.

Based on the HyperWeb prototype a product will be developed. This product will become available at the beginning of 1992. At the Bull site in Phoenix HyperWeb is currently used to maintain code. The intention of this pilot project is to learn to efficiently use the hypertext technology for maintenance.

3.10 Comparing Current Repository Offerings (PCTE, IBM RM, IRDS)

Speaker: Mr Jean Bérubé

A study comparing PCTE with other current repository offerings was reported on by Mr Bérubé of Orsand Ltd. The initial focus of this study carried out for NIST, was the comparison of ISO and ANSI IRDS. However, in the report it will be made clear that there is more than those two: IBM Repository Manager and PCTE have also been included in the study.

In the study the data concepts, architectures and modelling conventions of the reviewed repositories were compared. Other aspects of repositories, like the information model and process modelling convention, have been left out. Comparing the information model, for instance, is not possible, since PCTE does not include a definition of a standard information model unlike IBM RM and IRDS.

Several ambiguities and confusions were identified during the study. When comparing architectures, confusion is caused by differences in the description of the conceptual, logical and physical architecture. All studied repositories support the Entity-Relationship Model for data modelling. However, it is not clear which model is precisely meant: the model as defined by Chen, the model based on the Network Data Model, the model based on the relational model, or an extended model. Moreover, confusion might be caused by the distinction between model semantics and model notation.

To resolve the data model ambiguities, a reference framework was used. In this framework the following modelling concepts are included: records, record references or constraints, composites (aggregation), subtypes and views. For each of these concepts the corresponding data modelling facilities of a particular repository have been identified. However, some of the concepts cannot be

realized in a particular repository. The results of this data model comparison were summarized in a table included in the final report of the study.

4 TOOL-BUILDERS' DAY, FRIDAY 27 SEPTEMBER 1991

On the Tool-Builders' Day, the last day of the conference, several tool-builders described their experiences with the integration of their tools in PCTE-based environments. At the start of the day, there were two more general talks: one on tool documentation, the other giving an introduction to PCTE. In general, PCTE was considered a very useful backbone for integrating CASE tools. However, a need was felt for more guidance, for instance, in the form of migration guides.

4.1 Documenting tools for PCTE based environments

Speaker: Miss Margaret Aldis

The fundamental purpose of documentation is to give the user knowledge needed to support his actual tasks. Three major requirements that the documentation should meet can be given. When a user needs information, he wants to spend as little time as possible getting it. So the documentation needs to be accessible, accurate, and complete, and needs to present its information in the users' terms. From the software supplier's point of view, documentation creation, maintenance and delivery need to be trouble-free and economical. Furthermore, the documentation is expected to fulfil a marketing role in promoting the image of the product and the supplier.

Commonly, three dimensions are distinguished in integration of tools in an environment like PCTE. These three dimensions have their own impact on documentation. Integration of presentation means that several tools have the same 'look and feel'. So it's often not possible for a tool-builder to document the way the user sees the tool. Data integration implies that data can have meaning beyond the functionality of a specific tool. This fact can have an important impact on documentation. Because tools tend to be functionally integrated, tool boundaries start to disappear and documentation has to be 'task-oriented' rather than 'tool-oriented'. So it seems to be useful to add a fourth dimension to the tool integration space: the documentation integration.

As PCTE is taken up more widely, integration activities are less and less to be performed with close cooperation. In this situation definition of responsibilities and rules for integration including integration of documentation is very important. In general, tool-builders have to provide tools, data models and documentation in an integratable form. Environment-builders are to form an integrated whole.

Implicit in the integration process is some degree of reusability of documentation. In this context there are many technical issues like interchange standards and configuration management. One of the most difficult problems is the context-sensitiveness of parts of documentation: a piece of text or a diagram in one context does not necessarily mean the same as it does in another context.

4.2 PCTE for tool-builders

Speaker: Mr Régis Minot

From the user's point of view a PCTE tool is a program supporting one or more activities of the software development process that can be ported to any PCTE-based environment. Two types of tools can be distinguished. Horizontal tools, on the one hand, are tools applicable in all phases of the software development process. Examples of horizontal tools are version management tools and documentation support tools. Vertical tools, on the other hand, are tools dedicated to a specific phase in the software development process. Examples of vertical tools are design tools and maintenance support tools.

From a tool-builder's point of view a PCTE tool is a program designed to be ported and integrated in a PCTE based environment. Several levels of portability can be distinguished. At the highest level, a PCTE tool directly invokes PCTE and X11 operations. Tools at this level can be directly ported to all PCTE implementations. At the second level a PCTE tool invokes operations of common services built on top of PCTE and X11 (like the Broadcast Message Server (BMS) OPEN LOOK or MOTIF). Portability of such tools is achieved through the portability of these common services. At the third level, a PCTE tool invokes other PCTE tools or tool components. Portability of such tools is achieved by portability of the tools or tool components. At the fourth and lowest level, a PCTE tool invokes foreign tools. Portability of tools at this level depends on portability of the foreign tools.

Besides levels of portability also degrees of integration can be distinguished. At the highest level, a PCTE tool is designed to be integrated with a specific PCTE environment[4]. Tools at this degree of integration must have knowledge of existing data structures and have to be designed to be plugged in existing schemas. At the second level, a PCTE tool is designed to be integrated in a PCTE framework[5] which offers certain services. Of course such tools can only be integrated in frameworks providing these services. At the third and lowest level of integration, a tool is designed to be integrated in any PCTE based framework or environment. In this situation only few hypotheses on other tools and schemas have to be made. The design of the tool's private schemas must be made in strong isolation.

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[4] An environment can be defined as a set of vertical tools built on top of a framework.

[5] A framework can be defined as a set of horizontal tools and common services.

Three dimensions of integration can be distinguished[6]: data integration, control integration and user interface integration. In general the design of a PCTE tool can be done by performing the following steps:

- data integration
  - design your data schema
  - specify invariant semantics
- control integration
  - associate operation with data
- user interface integration
  - design interaction with user
  - relate interaction with operations

At the end of his presentation Mr Minot summarized Emeraude's experience with PCTE tool design:

- tools must be designed with integration considerations;
- through the OMS, PCTE solves a large part of data integration problems which otherwise would imply high development costs;
- error recovery is considerable simplified with transactions;
- transparent distribution and concurrent access are managed by PCTE with almost no cost for tool builders;
- PCTE tools can access foreign systems (e.g. Unix file systems) and call foreign tools in a controlled and portable way (encapsulation);
- performance is close to native system performance;
- PCTE must be complemented by a UI presentation package and possible higher level control integration services.

4.3 PME: The Project Management Environment

Speaker: Dr Hans E. Keus

In the context of the assessment phase of PCTE+ programme two projects have been planned by the Netherlands industry. The first project is the development of a Project Management Environment (PME). The project, started in May 1989, will end in March 1992 and is undertaken by Westmount Technology. To carry out the second project this organization is complemented by BSO/Aerospace & Systems. The purpose of this project is to carry out a real life cycle project to assess PCTE from an environment user's point of view.

The purpose of the PME project is to develop a project management workbench. The workbench is to run on Unix-s and VMS-based PCTE. The aim of the development is to assess PCTE from a tool builder's point of view. The PME to be developed is an interactive, multi-window

[6]These dimensions are defined in the NIST/ECMA CASE Reference Model and are emphasised by the 'toaster model' of HP.

management workbench with functionalities for organization modelling, resource modelling, user role modelling, project definitions, planning, monitoring and reporting.

One of the PCTE shortcomings experienced during the project was the lack of a fine grain object query language. Furthermore, the need was felt for standard public SDSs and tool migration guide-lines. SDSs are necessary (but not sufficient) for easy and successful tool integration. In general, there is a growing acceptance of PCTE. Further standardization (ISO) may be conducive to further acceptance. PCTE can be very beneficial for an open architecture.

4.4 A Broadcast Message Server on PCTE

Speaker: Paul Vickers

HP combined the tool integration facilities offered by three mature CASE integration technologies: PCTE (providing Data Repository Services and Data Integration Services), Motif (providing User Interface Services) and HP's SoftBench (providing Message Services and Task Management Services). SoftBench is an extensible and easy-to-use environment. The tool integration framework contains an integrated set of tools for program construction, program analysis and version management. Third party tools covering the lifecycle are integrated in the framework.

HP re-implemented the SoftBench Message Server on top of PCTE, to produce an open framework that provides control integration. The functional behaviour of a BMS environment is as follows: tools register their interest in particular messages. Tools also send messages to the BMS that selectively broadcasts them. A tool can respond to appropriate messages in return.

The BMS approach described above is conceptually simple and doesn't insert any significant performance overhead. It provides a flexible, evolutionary way for tools designed independently to cooperate. The SoftBench BMS uses PCTE facilities for process execution and inter-process communication.

HP's major experience with PCTE is that PCTE does provide help for the tool-writer although (or may be thanks to the fact that) tool-writers have to make engineering trade-offs. Migration of tools from Unix to PCTE is possible because there are pragmatic solutions for interworking between PCTE and Unix. At the moment there is not enough support available for PCTE tool-writers. For example, more guidance is needed on design, performance optimization and migration. A PCTE user group may be useful to share experiences and to agree on schemas. HP will follow the approach described above for its framework product.

4.5 The ENTREPRISE II environment

Speaker: Dr Amaury Legait

The ENTREPRISE II environment is an IPSE supporting management and control of development and maintenance. The environment has been created under pressure of real-life users.

The requirements on the IPSE emanate from two issues. Firstly, the development of the IPSE is a very large project. In the project several industries with differing nationalities cooperate. The sites concerning the project are highly distributed. Furthermore, the system to be developed has a very long life. In such a project management of costs, delays, quality and maintenance is a hard job.

From this first issue the following requirements can be distilled:

- standards must be used throughout the project;
- the solution must be portable;
- the IPSE configuration must be managed;
- the maintenance of the IPSE must be managed.

The second requirements issue is "integration". The best known integration factors are the technical factors. Four technical integration factors can be distinguished.

- Data integration can be achieved at various levels. Firstly, the tools are data-integrated by hosting them. Secondly, the tools are data-integrated by integrating them on PCTE. Thirdly, the tools are data-integrated by integrating them information system part of the IPSE.
- Presentation integration results in a consistent interaction with all tools. ENTREPRISE II uses OPEN LOOK and MOTIF.
- Process integration is achieved by defining roles and tools and by declaring tools.
- Openness is the last technical integration factor. The IPSE has to be open to foreign data, to foreign tools and to other User Interfaces. Clearly, there is a strong relationship between openness and the other three technical integration factors.

Non-technical integration factors are often more important and hard to meet than the technical ones. Important examples of these factors are:

- Costs
- Delays
- Industrial property
- Maintenance of the IPSE

The framework of ENTREPRISE II consists of an information management part, a process management part and a reuse management part. These parts are integrated on top of PCTE 1.5 (hosted on Unix) and use a common user interface. The environment is completed by configuration management, documentation management and project management tools and a set of tools supporting the various phases in the development process.

4.6 VULCAN/AD - Analysis and Design Tool

Speaker: Mr B.P. Bhat

VULCAN is a CASE Environment providing an integrated set of CASE functions. The basic support for these functions is provided by common service modules like presentation and user interface services, and object management services.

The core of the architecture consists of a repository containing all user-provided and generated information related to projects. This ensures the integrity of the data and provides a means of enforcing security constraints. The functional specifications of the repository are based on the PCTE+ model.

The Object Management System consists of a set of access routines built over the repository to provide users and CASE tool developers an object-oriented view of the data contained in the repository.

VULCAN has a Graphical User Interface (GUI). The GUI is consistent and uniform across all functions and tools of the environment. It is based on OSF/MOTIF and the underlying X Windows System. In addition, a command language allows users to access tool functions without going through the GUI.

The Application Programming Interface (API) consists of a collection of C++ class definitions and functions to access and manipulate objects in the VULCAN environment.
A Direct Repository Interface is provided to enable other tools to store and retrieve information in the VULCAN repository. It consists of a collection of C-bindings to access PCTE+ services.

The Tool Integration Service is designed to accommodate new tools within VULCAN by extending the user interface. It will be possible to integrate a new tool and still maintain consistency with the rest of the tools in the environment.

VULCAN is intended to provide extensive software engineering support, and is expected to meet the needs of various classes of users, including software project managers, analysts, designers, programmers, testing & validation staff, maintenance staff, etc.

4.7 Tool Integration

Speaker: Mr Bryan Basdell

Integration within a project support environment can be defined as:

> "Integration concerns the degree of cohesion and interaction of components within the project support environment, such that the environment appears coherent to the user."

Four different types of integration can be distinguished: functional, data, control and presentation integration. Besides these integration types, two different dimensions integration can be achieved

in, can be distinguished: horizontal and vertical. Horizontal integration is mutual integration of tools. Vertical integration is integration of tools and support services.

Vertical Integration can be approached in different ways. The approach spectrum varies from Foreign process integration via Interface layer integration to Source port integration. Foreign process integration is a very loose and cheap type of integration. An example of foreign process integration is integration of an Ada compiler with an operating system like VMS. This integration is relatively cheap because there is no need for re-validation of the compiler. Interface layer integration is a relatively loose type of integration. An existing tool is encapsulated in an interface layer. This type of integration degrades the performance because of translation by the interface layer. Horizontal integration of tools can not easily be combined with interface layer integration. Source port integration is a very tight and expensive type of vertical integration. Horizontal integration of source port integrated tools can be achieved relatively easy.

	Vertical Integration	Horizontal Integration
Functional	use of facilities of PCTE rather than OS (independent security policy)	interoperability without redundancy, duplication or omissions
Data	use of OMS for persistent data (schema definitions)	common formats supporting concurrent and multiple access
Control	use of invocation, scheduling, execution... (transactions and rollbacks)	process management
Presentation	uniformity of interaction, manipulation and presentation of data	common style of presentation and interaction

4.8 STAR: the requirements analysis environment

Speaker: Dr Aytül Erçil

Turkey entered the PCTE+ project in the assessment phase in October 1988. The contribution to the project is to develop a requirement analysis tool under Unix, to port that tool to PCTE+, and to assess the porting process.

The requirement analysis tool is STAR (Structured Analysis of Requirements). STAR supports the structured modelling of information systems and real-time systems. The tool supports data modelling (ERD) and activity modelling (control flow diagram and time dependency charts). Currently, a prototype of the Unix version of STAR is finished. The design of the PCTE+ version of STAR is going on. This version is planned to be ready in February 1992.
A few problems have been encountered during the port to PCTE+, as there are lack of sufficient porting guidance and of C++ bindings.

4.9 Early feedbacks from the assessment phase

Speaker: Mr Gérard Boudier

In the years 1987 and 1988 PCTE releases 1.4 and 1.5 provided input for the definitions phase of PCTE+. During the years 1989 up to 1992 PCTE+ will be assessed. In parallel, ECMA PCTE will developed. PCTE+ and its assessment will provide input for this development.

The PCTE+ assessment is an international collaborative effort of several cooperating nations. Its objectives are:

- to assess the implementability, usability and effectiveness of the PCTE+ specification;
- to guide revision and completion of the PCTE+ specification;
- to provide sufficient confidence to support the promotion of the final specification as an international standard.

Within the assessment phase three main activities can be distinguished. Firstly, a number of PCTE+ implementations are developed. Currently, a SUN/Unix implementation is available. A VAX/VMS version will be available mid 1992. Secondly, PCTE+ based tools are provided. Thirdly, the proper work in the assessment phase is assessment work. The resulting assessment is based on the first two activities. Assessment also results from porting of tools from one interface implementation to another.

The output of the assessment phase is twofold. During the assessment phase comments on the PCTE+ specification are submitted to the PCTE+ Definition Team. The second output component is a final assessment report produced at the end of the assessment phase. In fact this final report will be a synthetic summary of all contributor's assessments.
Before a comment is inserted in the several assessment documents modifications, responses and changes may be added to it, and it is reviewed by the Definition Team.

The relationships with ECMA TC33 are:

- TA-13 is represented in the ECMA TC33 committee;
- several members (or ex-members) of the PCTE+ Definition Team participate in the ECMA TC33/TGEP workshops;
- all appropriate documents (PCTE+/FR, PCTE+/CONREP and PCTE+/CHANGES) are sent to ECMA TC33;

- some comments on the PCTE+ specifications have already been taken into account in the ECMA PCTE abstract specifications.

4.10 Porting Arcs to PCTE, practical experiences

Speaker: Mr Anders Lundkvist

Arcs is an Ada Programming Support Environment (APSE), which is 'data-integrated' with the Telesoft Ada Compiler TeleGen2. In this context data-integrated means that Arcs works on the same internal data structures as does the compiler.

Telia Research[7] ported the APSE from Unix to PCTE. The porting strategy was:
1. make a first port of Arcs and TeleGen2 using a solution as simple as possible;
2. use ported environment as development environment;
3. start exploring the facilities provided by PCTE.

Following this strategy some sort of evolutionary approach has been adopted. The advantage of this approach is that always a working APSE is available and it can be tested continuously.

For the first simple port, a one-to-one mapping of Unix files on PCTE objects was used because a granularity decision can have high impact on the required effort. Besides the mapping some change appeared to be necessary in naming conventions and command syntax. In this first ported version the PCTE OMS is used in a very simple way. Some advantages of this usage of OMS can be given already:
- referential integrity;
- sharing of sublibraries between libraries is made explicit;
- sharing of source text between sublibraries is made explicit.

4.11 The AdaNICE toolset on PCTE

Speaker: Mr Nando Gallo

AdaNICE is a set of tools related to system design. The toolset is compliant with HOOD Version 1.3. It supports reuse of design, design metrics, template driven design document generation and code generation. AdaNICE is highly user configurable and open to integration with external tools.

Within AdaNICE, a project can be partitioned into subprojects in order to allow parallel developments. The tools are 'presentation integrated' using a Dialogue Manager. This Dialogue Manager is built on top of X/11. By sharing a database the tools are 'data-integrated'. This database is partitioned in two parts: a Run Time Data Base (RTDB) and a HOOD Project Library (HPL). The HPL is encapsulated in a HPL Manager. This HPLM provides a logical representation of the Project Library independent from the kind of repository and the physical representation in

[7] Telia Research is the new research subsidiary of Swedish Telecom Administration (Televerket). Televerket is the owner of TeleSoft. The Swedish part of TeleSoft was at the beginning of 1991 incorporated in Telia Research.

the repository. The RTDB enables efficient displaying of graphical information and hides and centralizes implementation decisions related to load/save approaches.

Loading information from and saving information to the HPL can be done in two ways, either in a single step or incrementally. The single step approach works as follows: when a subproject starts, all information needed is loaded from the HPL into the RTDB. All HPL updates are stored temporarily in a so called Working Area. When the subproject is committed the HPL will be permanently updated. In the incremental approach the information will be loaded incrementally from the HPL into the RTDB. The updates fo the HPL will also be saved incrementally to the HPL. All updates can be cancelled, however, before the subproject is committed.

The HPL is implemented on the OS file system. Structural information of a subproject is stored in a Master file. Additional information on HOOD objects is stored in secondary files. The Master file is loaded when the subproject is opened, creating the RTDB in the core memory. Secondary files are loaded when needed.

Porting the AdaNICE toolset to PCTE there are four possible organizations of the database:

1. represent the HPL structure in the OMS as it is on the File System, defining a "Unix emulation" schema;
2. represent only HOOD objects and their include and use relations as OMS objects and relationships;
3. represent major HOOD entities (objects, operations, operation sets, require interfaces, etc.) as OMS objects and their relations as OMS relationships;
4. represent all HOOD entities (3+types, constants, operation parameters etc.) as OMS objects and their relations as OMS relationships.

To decide which one of the four organizations is the best one, three evaluation criteria have been used:

A. openendness/integratability
B. efficiency
C. porting/implementation cost.

Based on these criteria the third organization has been selected because this organization:

- allows to achieve a high degree of openendness and of integratability of the toolset, since the most relevant information is described in the schema;
- allows to fully exploit and assess the capabilities of PCTE;
- allows to achieve an acceptable level of efficiency through a proper run-time data organization;
- introduces acceptable implementation cost and design complexity.

Assessing the PCTE OMS a few problems have been encountered.

- Link's Keys cannot be changed (specification bug).
- There are no facilities for defining an order among links and for sorting links (missing feature).
- The possibility to define light-weight objects with a reduced set of pre-defined attributes has been missed.

Some of the PCTE OMS features have proven to be particularly useful, since they include: nested transactions and SDS/Working Schema mechanisms (to separate between AdaNICE internal view and 'public' view (interface with other tools)).

5 REFERENCES

[1] IEPG TA-13, Introducing PCTE+, Indepedent European Programme Group, Technical Area 13

[2] M. Morron: NIST Statement at ECMA TC33, PCTE Newsletter number 8

[3] Letter to the Editor, PCTE Newsletter number 6

[4] F. Sallé: PCTE Interface Management Board, PCTE Newsletter number 6

[5] J-D. Zucker: Developing IPSEs on PCTE: the ALF Approach, PCTE Newsletter number 8

[6] M. Lichtenhein: East World Premier, PCTE Newsletter number 7

[7] J. Ferrans: the Hyperweb Project, PCTE Newsletter number 7

[8] K. Thompson: PCTE, IRDS and CDIF: Competitors or Collaborators, PCTE Newsletter number 9

[9] The Entreprise II Environment, PCTE Newsletter number 7

[10] A. Lundkvist: Porting ARCS to PCTE: practical experience, PCTE Newsletter number 5

J. Mager	W. Treumiet	D. Fikkert
(author)	(author)	(group leader)

APPENDIX A

PCTE '91 PROGRAM

WEDNESDAY 25 SEPTEMBER ***DECISION-MAKERS' DAY***

Chairman Dick Fikkert, TNO Physics and Electronics Laboratory, The Netherlands

07.45 Bus departs from Juno Hotel
07.30 - 16.00 Registration
08.30 - 08.50 Speakers' Meeting (Secretariat)
09.00 - 17.45 Exhibition

09.00 **Welcome and Opening Address**
Mr P. Spohr — *Director*
TNO Physics and Electronics Laboratory, The Netherlands

Organizations behind PCTE

09.20 **PCTE Standardisation**
Mr Myer W. Morron — *Director Systems Strategy, Chairman ECMA TC33*
BNR Europe, UK

IEPG TA-13
Dr Brian Gladman — *Chairman, Independent European Programme Group, Technical Area 13 (IEPG TA-13)*
Ministry of Defence, UK

PCTE is the Open Repository
Mr Robert Cochran — *Managing Director, Executive Committee of PIMB, Chairman PCTE Promotion Group*
Catalyst Software, Ireland
This paper will outline the rapidly accelerating momentum in support of PCTE and will show how the PCTE community (and in particular PIMB and PPG) have been one of the instruments of this success.

Commission of the European Communities
Mr D. Talbot
DG XIII, TII&I and ESPRIT
CEC, Belgium

10.40 - 11.15 Coffee Break

Industrial PCTE Strategy

11.15 **Digital's PCTE Strategy**
Mr Luciano Vernocchi — *CASE Senior Product Manager*
Software Development Technology Group
Digital Equipment Corporation, Italy

PCTE as HP's CASE Repository
Mr George Tatge — *Framework Interoperability Program Manager*
Software Eningineering Systems Division
Hewlett Packard Company, USA

WEDNESDAY 25 SEPTEMBER **DECISION-MAKERS' DAY**

BAe (MA)L Policy for Software Engineering Environments
Mr Phil Thornley *Principal Engineer*
British Aerospace (Military Aircraft) Ltd., UK
The presentation describes experience with Eurofighter IPSE, current research work, and future requirements.

Need for Standard - IBM Viewpoint
Mr Germain Sagols *Senior Consultant*
European AIX CASE Center
IBM, France
IBM are now committed to open systems as a strategy direction. For the future IBM's intention is to populate the ECMA Reference Model with a standardized system or interface. At present a standard for data repository services exists in the form of PCTE, while IEEE POSIX is a standard operating system definition.

12.45 - 14.00 Lunch

13.30 - 13.50 Speakers' Meeting (Secretariat)

14.00 **The STARS Program and PCTE**
Dr John F. Kramer *Program Manager (STARS/SEI)*
Software and Intelligent Systems Technology Office (SISTO)
Defense Advanced Research Projects Agency (DARPA), USA
The Software Technology for Adaptable, Reliable Systems (STARS) program is a US DARPA program to develop, integrate and demonstrate advanced software engineering technology. As part of the program, STARS will demonstrate three integrated Software Engineering Environments on three real applications.
STARS is part of a larger effort including STARS, the Software Engineering Institute (SEI) and the US Ada Program.

14.20 **Panel**

Technology Push, Smart Buyers, and Market Pull. The Forces Accelerating PCTE?

Chairman
Mr E. van Hoek *Director*
Defence Research and Development (DWOO)
Ministry of Defence, The Netherlands

Members

Mr Ian G. Campbell	*Mr David Talbot*
Mr Myer W. Morron	*Mr George Tatge*
Mr Germain Sagols	*Mr Luciano Vernocchi*

15.45 - 16.15 Tea Break

16.15 **A Management Introduction to PCTE**
Mr Ian G. Campbell *Managing Director*
Emeraude, France

17.15 End of Sessions
18.00 Busses depart to City Reception
18.45 Reception Offered by the City of The Hague
20.15 Busses depart to the Hotels

THURSDAY, 26 SEPTEMBER **APPLICATION-BUILDERS' DAY**

Chairman Prof. Dr Udo Kelter, University of Hagen, Germany

08.00 Bus departs from Juno Hotel
08.00 - 16.00 Registration
08.30 - 08.50 Speakers' Meeting (Secretariat)
09.00 - 17.00 Exhibition

09.00 **To Build an Environment on top of PCTE**
Professor J.C. Derniame
CRIN-University of Nancy, France
The experience of the ALF project development, a software process model centered development environment, allows some conclusions on the usefulness of PCTE.

Meeting User Requirements for Control in a Large Scale IPSE
Mr Martin Kirby *Technical Architect - PCTE+ Assessment*
SD-Scicon Ltd., UK
The speaker will describe the major control requirements for the IPSE in support of the Eurofighter Aircraft Project. The ease with which these can be met by PCTE will be demonstrated and benefits to the application builder described.

EAST Environment
Mr Jean-Philippe Bourguignon *Managing Director*
SFGL, France
The EAST Environment is an open, integrated environment exploiting PCTE to achieve a high level of flexibility.

10.30 - 11.00 Coffee Break

11.00 **Object Granularity in the Concerto Repository**
Mr Edouard André *Concerto Product Manager*
SEMA Group, France

The Case Data Interchange Format (CDIF) Standards
Mr Mike Imber *Consultant*
Chairman CDIF Technical Committee

R&D Group
LBMS, UK
The talk will cover the CDIF standards and their relevance to PCTE.

THURSDAY, 26 SEPTEMBER ***APPLICATION-BUILDERS' DAY***

12.00 - 13.30 Lunch
13.00 - 13.20 Speakers' Meeting (Secretariat)

13.30 **Toolbuilder and the Open Repository**
Mr Paul Harris *Consultant*
IPSYS Software PLC, UK

Implementation of a Complex Software Development Environment - EPOS in a PCTE+ Environment
Mr H.G. Rau *Senior Consultant*
GPP Gesellschaft für
Prozessrechnerprogrammierung mbH, Germany
Some remarks on the implementation goals of a complex CASE tool, the benefit expected from PCTE+ use and the implementation problems envisaged.

PCTE Training - Experiences of UCW Aberystwyth
Dr Mark Ratcliffe *Lecturer*
University College of Wales, UK

15.00 - 15.30 Tea Break

15.30 **The HyperWeb Project**
Dr Gérard Memmi *CASE Mission Manager*
Bull, USA

Comparing Current Repository Offerings (PCTE, IBM RM, IRDS)
Mr Jean Bérubé *Principal Consultant*
Orsand Ltd., UK
The presentation introduces the approach, identifies key items in the comparison, and concludes on the potential of open repository environments.

16.30 End of Sessions

17.15 Bus departs to Juno Hotel

19.00 **BoF session(s)**
PCTE meets CFI?

FRIDAY, 27 SEPTEMBER **TOOL-BUILDERS' DAY**

Chairman Hugh Davis, ICL, UK

08.00 Bus departs from Juno Hotel
08.30 - 12.00 Registration
09.00 - 16.30 Exhibition
08.30 - 08.50 Speakers' Meeting (Secretariat)

09.00 Documenting Tools for PCTE-based Environments
Ms. Margaret Aldis *Partner*
Syntagma, UK
Syntagma is a small UK-board organisation which designs, writes and produces user documentation. Syntagma's PCTE-based work includes the PACT user documentation, 'Introducing PCTE+', and documentation for Emeraude, Entreprise II and EAST.

PCTE for Tool-Builders
Mr R. Minot *Technical Director*
Emeraude

PME: The Project Management Environment
Dr Hans E. Keus *Manager Strategic Developments*
Westmount Technology B.V., The Netherlands
The PME developed on the PCTE+ platform will become part of the existing ICASE toolsets which include complete documentation facilities and belongs to the most comprehensive Software Engineering Environments available on UNIX and VMS platforms.

10.30 - 11.00 Coffee Break

11.00 A Broadcast Message Server on PCTE
Mr Paul Vickers *Project Manager*
Hewlett packard Research Laboratories Bristol, UK
We describe work to combine the tool integration facilities offered by two of the most mature CASE integration technologies: PCTE and Hewlett Packard's SoftBench product.
We have re-implemented the Softbench Broadcast Message Server on top of PCTE, to produce an open framework that provides control and data integration. By an 'open' framework, we mean one that is standards-based and offers a member of options for moving existing tools to the framework.

The ENTERPRISE II Environment
Dr Amaury Legait *Head of Department*
SYSECA, France
During the development of ENTREPRISE II we used PCTE as the data integrator. ENTREPRISE II provides more services than PCTE: dynamic and static configuration management, project management, etc. The experience gained in integrating tools in a PCTE based environment, allows us to define integration paths and integration levels.

12.00 - 13.30 Lunch

FRIDAY, 27 SEPTEMBER ***TOOL-BUILDERS' DAY***

13.00 - 13.20 Speakers' Meeting (Secretariat)

13.30 **Tool Integration**
Mr Bryan Basdell *Manager*
Software Engineering Consultancy
SD-Scicon, UK
Issues of Tool Integration Being Considered in PCTE+ Implementation Hosted on VAX/VMS

STAR: the Requirements Analysis Environment
Dr Aytül Erçil *Associated Professor*
Bogazici University & STFA Savronik (Tu)

Early feedbacks from the assessment phase
Mr Gérard Boudier *R&D Department Manager*
Emeraude, France
A short presentation of the assessment phase (participants and activities) and overview of its first available results.

15.00 - 15.30 Tea Break

15.30 **Porting Arcs to PCTE, Practical Experiences**
Mr Anders Lundkvist *System Design Engineer*
Telia Research, Sweden
The presentation shows that despite the fact that a rather simple approach has been followed, a number of substantial advantages have been achieved when using PCTE.

The AdaNICE Toolset
Mr F. Gallo *Software Engineering R&D Manager*
Intecs Sistemi SpA, Italy
AdaNICE is a set of tools which is available as a stand alone commercial product on platforms such as SUN, DEC, HP workstations and on PCTE 1.5 (Emeraude). It is being ported on PCTE+ in the context of the TA-13 CTP.

16.30 - 16.35 Closing
17.00 Bus departs to Central Station

APPENDIX B

LIST OF PARTICIPANTS

Abbatangelo, Lt. Cdr. G.	Ministero Marina-Navalcostarmi	Italy
Agema, Mr W.A.	Koninklijke Luchtmacht	The Netherlands
Aldis, Ms. M.J.*	Syntagma	United Kingdom
André, Mr E.*	SEMA Group	France
Antippas, Mr E.	Alpha Sai	Greece
Argento, Mr A.	Digital Engineering	Italy
Baldwin, Mr A.P.	U.K. MOD (PE)	United Kingdom
Barry, Dr B.	Object Technology International Inc.	Canada
Basdell, Mr B.W.*	SD-Scicon	United Kingdom
Belderbos, Mr C.M.N.	TNO-DO	The Netherlands
Bérubé, Mr J.*	Orsand Ltd.	Canada
Bhat, Mr B.P.*	Heuristix systems Pvt Ltd	India
Black, Mr E.	Atherton Technology	USA
Blom, Mr R.N.M.	Océ-Nederland BV.	The Netherlands
Bogaards, Dr K.	Information Technology Architecture BV	The Netherlands
Bond, Ms. S.G.	RSRE DRA MoD UK	United Kingdom
BostrËm, Mr A.	ELLEMTEL Telecom Sys. Labs.	Sweden
Boudier, Mr G.*	Gie Emeraude	France
Bourguignon, Mr J.P.*	SFGL	France
Bruso, Ms. K.L.	UNISYS	USA
Cakir, Ms.	MoD, Turkey	Turkey
Campbell, Mr I.G.*	Emeraude, Syseca	France
Camus, Mr J.L.	Verilog	France
Cayatte, Mr O.	Corelis	France
Cochran, Mr R.*	Catalyst Software	Ireland
Colyn Devardiere, Mr		France
Cureton, Mr W.H.	Sun Microsystems	USA
David, Mr	TRT-Philips	France
Davis, Mr H.F.*	ICL	United Kingdom
de Greef, Mr B.L.	Philips Research	Germany
de Hartog, Mr J.A.	Digital Equipment BV	The Netherlands
de Jong, Mr S.	NLR	The Netherlands
de Pagter, Mr P.J.	NLR	The Netherlands
Demirtas, Col. I.	MoD, Turkey	Turkey
Demiame, Prof. J.C.*	CRIN	France
Didelot, Mr F.	THOMSON SINTRA ASM	France
Downes, Ms. V.A.	OVUM Ltd	United Kingdom
Dull, Mr J.P.	Uniface	The Netherlands
Duval, Mr S.	Verilog	France
Erba, Ms. A.	Lombardia Informatica	Italy
Erçil, Prof. A.E.*	STFA Savronik A.S.	Turkey

Fikkert, Mr D.W.*	TNO-FEL	The Netherlands
Fischaleck, Ms. M.	IABG	Germany
Florijn, Mr G.H.	SERC	The Netherlands
Gallo, Mr F.*	Intecs Sistemi SpA	Italy
Gladman, Dr B.R.*	Ministry of Defence	United Kingdom
Gouin, Mr D.	Defence Research Establishment Valcartier	Canada
Grambert, Mr A.	Hewlett Packard/OSE marketing	Germany
Grant, Mr T.J.	BSO/Aerospace & Systems BV	The Netherlands
Haertel, Mr F.	MOD Germany	Germany
Harris, Mr P.*	IPSYS Software PLC	United Kingdom
Hayashi, Mr K.	SRA Inc.	Japan
Hayter, Mr K	RSRE	United Kingdom
Hijwegen, Mr A.	Data Sciences BV	The Netherlands
Hirdes, Mr F.P.	Techforce BV	The Netherlands
Hodgson, Mr R.	IDE	United Kingdom
Hurst, Mr D.	Vista Technologies, Inc.	USA
Ijuin, Mr I.	Software Research Associates, Inc.	Japan
Imber, Mr M.P.F.*	LBMS	United Kingdom
Jimmink, Mr R.A.	PTT Research	The Netherlands
Kelter, Prof.Dr U.*	FernUniversitÂt, Gesamthochschule	Germany
Kent, Ms. J.A.	Syntagma	United Kingdom
Keus, Mr H.E.*	Westmount Technology	The Netherlands
Kirby, Mr M.W.*	SD-Scicon UK Ltd.	United Kingdom
Kishida, Mr K.	SRA Inc.	Japan
Koolma, Dr R.D.	TNO-FEL	The Netherlands
Kotsakis, Mr G.	National Defence Research Center	Greece
Kramer, Mr J.F.*	Darpa	USA
Kutluoglu, Mr S.F.	STFA Savronik Inc.	Turkey
Laagland, Mr P.J.	BSO/Aerospace & Systems	The Netherlands
Legait, Dr A.*	Syseca	France
Leung, Ms. R.	Bellcore	USA
Lewis, Mr G.R.	Sun Microsystems Inc.	USA
Lichtenhein, Mr M.	SFGL	France
Longden, Wing Cdr. D.A.	UK MoD (PE)	United Kingdom
Luijten, Mr B.F.M.	TNO Building and Construction Research	The Netherlands
Lundkvist, Mr A.*	Telia Research	Sweden
Maegaard, Mr H.	CRI	Denmark
Mager, Mr J.W.L.J.	TNO-FEL	The Netherlands
Magrassi, Dr P.	Gartner Group	Italy
Matsumoto, Dr Y.	Kyoto University	Japan

Matsumura, Mr Y.	SRA Inc.	Japan
Matsuo, Mr M.	Software Research Associates Inc.	USA
Mattsson, Mr H.	Ellemtel Telecom Systems Labs	Sweden
McLean, Mr C.F.	Groupe Bull	USA
Memmi, Dr G.*	Groupe Bull	USA
Messenio, Ms. N.	Bull Italia	Italy
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Minot, Mr R.*	GIE Emeraude	France
Moignot, Ms. M.	SFGL	France
Montminy, Mr P.	DMR Group Inc.	Canada
Morron, Mr M.W.*	BNR Europe Ltd.	United Kingdom
Mulder, Mr W.	Hollandse Signaalapparaten BV	The Netherlands
Nieuwenhuis, Dr C.H.M.	Hollandse Signaalapparaten BV	The Netherlands
Oliver, Dr H.E.	Hewlett Packard Labs, Bristol	United Kingdom
Oren, Dr T.I.	University of Ottawa	Canada
Pasquali, Dr V.V.	ICL	United Kingdom
Penot, Mr G.	DETN - SIMA	France
Petry, Dr	AEG Electrocom	Germany
Pitette, Mr G.	SFGL	France
Post, Cdr. (WE) J.H.	KM/CAWCS	The Netherlands
Purvis, Mr K.O.	ERA Technology	United Kingdom
Ragsdale, Mr J.	SofTech, Inc.	USA
Rankin, Mr R.M.	Defence Research Agency	United Kingdom
Ratcliffe, Dr M.*	University College of Wales Aberystwyth	United Kingdom
Rau, Mr H.G.*	GPP mbH	Germany
Remkes, Mr D.	SofTech, Inc.	USA
Riddle, Mr W.E.	SDA inc.	USA
Roach, Mr	Digital Equipment	France
Rogers, Mr M.W.	CEC	Belgium
Rooijers, Mr A.J.Th.	TNO-FEL	The Netherlands
Roubine, Dr O.	Verdix	France
Sagols, Mr G.*	IBM	France
Sasaki, Mr H.	CEG	Japan
Schmidt, Mr U.	BWB	Germany
Schouten, Mr G.S.	Icim	The Netherlands
Schravesande, Mr J.	TNO-ITI	The Netherlands
Schuberth, Dipl. Math. L.	FFM/RSP	Germany
Shate, Mr D.	Digital Equipment Corp.	Germany
Simon, Mr D.	CNES, TE/IS/MIS/PA	France
Solomond, Dr J.P.	Ada Joint Program Office	USA
Soufflet, Mr D.	Emeraude	France

Spohr, Mr P.*	TNO-FEL	The Netherlands
Streef, Lt.Col. J.	MoD NL (DEBKL/DCAWACO)	The Netherlands
Suarez, Mr N.	Isdefe	Spain
Szymanski, Mr R.	US Air Force	USA
Talbot, Mr D.E.*	CEC	Belgium
Tatge, Mr G.*	Hewlett Packard	USA
Thalman, Mr G.	Hewlett Packard	USA
Thomas, Mr M.I.	Hewlett Packard	USA
Thornley, Mr J.P.*	British Aerospace	United Kingdom
Tillson, Mr T.	Hewlett Packard	USA
Tily, Mr C.N.J.	UK MOD (PE)	United Kingdom
Treumiet, Mr W.	TNO-FEL	The Netherlands
van den Berg, Mr F.	Tasking BV	The Netherlands
van den Broek, Mr G.H.M.	Philips Research Laboratories	The Netherlands
van der Ham, Kol. B.P.	HWO-KL	The Netherlands
van Geest, Mr L.F.	KM/CAWCS	The Netherlands
van Goeverden, Mr W.	DEBKL/DCAWACO	The Netherlands
van Hoek, Mr E.A.*	DWOO	The Netherlands
van Kats, Mr J.M.	Convex Computer BV	The Netherlands
van Oosterom, Mr N.E.	TNO-ITI	The Netherlands
Vargenau, Mr	Alcatel Alsthom Recherche	France
Verbeek, Mr H.M.W.	Technische Universiteit Eindhoven	The Netherlands
Vernocchi, Mr L.*	Digital Equipment Co.	Italy
Vickers, Mr P.A.*	Hewlett Packard Labs. Bristol	United Kingdom
Vogel, Mr T.	TNO-ITI	The Netherlands
Voorman, Mr O.J.	Philips Research Laboratories	The Netherlands
Walker, Mr G.	Alcatel	France
Walsh, Ms. D.	Intecs Sistemi	Italy
Wareham, Mr P.E.	SD-Scicon	United Kingdom
Wijers, Mr G.M.	SERC	The Netherlands
Wohlschlegel, Mr W.	CEC	Belgium
Wybolt, Mr N.	Cadre Technologies Inc.	USA
Zerlauth, Mr P.	Alcatel Business Systems	France
Zinkiewicz, Ms. M.	DMR Group Inc.	Canada

*Speaker

Opening Address PCTE '91

(25-27 September 1991 in The Hague)
by

Mr. P. Spohr

Director
TNO Physics and Electronics Laboratory

I. INTRODUCTION

Ladies and Gentlemen,

it is my pleasure to welcome you at PCTE '91. I am particularly pleased that the interest for this conference is well-spread over 16 different countries from Europe, North America and the far east.

What I want to do is to present some thoughts grouped into three different topics that perhaps will help you to view PCTE from three different angles. The topics are:

1. Open systems
2. Technology Push and Market Pull
3. User needs at a management level

These thoughts are largely motivated by the fact that TNO-FEL is an advanced user of System Engineering technologies in research projects in the areas of:

- Observation Systems
- Information Technology and Telecommunication Systems
- Trainers and Simulators
- Policy Support Studies

Alltogether TNO-FEL has some 200 scientist applying Information and Telecommunications Technology. Of course we produce IT, but not in the area of systems engineering.

In short, we are an advanced user of information technology, whose main business is research. And users are nowadays closely connected to Open Systems, which is the first topic I want to address.

PCTE, in full "a basis for a Portable Common Tool Environment" is an open system in the area of CASE[1]. It is, however, difficult to find matching definitions of open systems. DMR group Inc., for example, defines Open Systems as commonly available products and technologies that comply with industry-wide, vendor-independent standards. One of the earliest examples of course is the ISO-OSI model and its protocols.

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[1] CASE: Computer Aided Software Engineering

Before I continue, first I would like to start with some simple definitions.

A user in my talk, and probably in the context of this conference, is the person who uses methods, tools (or SEEs[2]) and many other skills to build applications. Those applications are delivered to a client. The client hopefully has people around who use the application. Those people are called end-users.

The next definition defines open systems: a system is open if its interfaces are published, not counting the publication of its user interface.

The last definition defines smart buyers: a smart buyer includes life-cycle costs rather than the acquisition price in his decision to purchase a system. Quality, maintenance, enhancements, supplier independence and disposal are important terms for a smart buyer.

II. OPEN SYSTEMS

At least three types of open systems fit the definition:

P-type: A Proprietary Open System is a proprietary system the interfaces of which are published. Everyone can build upon these published interfaces. IBM's SAA[3] including AD/Cycle[4] is an example, but examples from the other participating companies in the industrial session of this morning could probably be given just as well.

D-type: De facto Open Systems are Defaced standard systems to which many products comply. The system, however, is still proprietary. The interfaces are "De facto" published and sometimes influenced by groups. Unix (before Unix International was formed) and DOS (proprietary) are prime examples.

S-type: Standardized Open Systems are systems of which the interface is agreed upon and standardized by groups (users and/or suppliers) or standardization bodies. A standardization body does not sell a standard compliant system, a group might also sell such a system. PCTE, OSI, X/Open, OSF/1, POSIX and graphics standards like PHIGS and GKS are examples.

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[2] Software Engineering Environment

[3] SAA: Systems Applications Architecture

[4] AD: Application Development

Even if you do not agree with the definition, you probably will agree with some of the advantages open systems have. According to a Price Waterhouse study, European managers expect lower costs, better value for money and a larger choice of suppliers by 1996. Based on that study, the advantages of open systems are:

- Portability (of applications)
- Value for Money
- Scalability (grow when needed)
- Flexibility (in choice)
- Integratability (of multi vendor components)

It is often forgotten that open systems have advantages for Users as well as Suppliers. The suppliers advantages include:

- Less risk at product introduction
- Broader base or larger initial market
- More stable market

Open systems also have their challenges (a positive approach for disadvantages). Based again on the mentioned study the challenges include:

- Migration. The period, problems, risks, costs of the transition from proprietary to open systems.
- Standards coverage. In which area are standards established and in which area do we need to establish standards?
- Competitive advantage. How can a supplier maintain a Competitive advantage if a large part of systems have to behave similar?
- Conformance. How well does a supplier's implementation conform to the standard? How portable is an application in reality?
- Security. Do current open system proposals include enough security features, compared to what proprietary systems offer?
- Continuity of suppliers. Do the undoubtedly lower profit margins assure continuity of suppliers?
- Human experts. The study claims that there is a lack of experts in open systems area.

PCTE is an S-type open system. It is up to you to determine whether PCTE meets the advantages and has tackled the challenges.

If you would take a look at groups involved in open systems you would find that these groups are largely supplier driven. Is this supplier dominance really surprising? We as a user will never build UNIX or PCTE. So we need suppliers who dare to invest and listen to user needs.
This brings us to two forces which comprise the second topic I would like to address: Technology Push and Market Pull.

III. SHIFT FROM TECHNOLOGY PUSH TO MARKET PULL

Let's first establish the fact that both approaches can be producers of technology. As a user I also think that we need both type of forces as producers of technology.

Yet, the shift from technology push to market pull (or user demand) is taking place in Europe and probably around the world. And of course it's fair to wonder whether all those new technologies help to improve company results, quality of our work, life or environment to name just a few. If the improvement cannot be noticed, the technology and development effort is wasted. That's what makes technology push a questionable approach. But of course many examples can be given that have led to improvements.

It is interesting to see that in a certain field an almost opposite move is being made with respect to the fact that a user (market) knows what he wants. The field is most relevant to this conference. It is System Development, specifically development of large scale CCIS's[5].
A number of people within NATO are convinced that Evolutionary Procurement (EP) is a better way to proceed compared to traditional procurement, which is largely based on the Waterfall Model.

A user can not fully specify what the system should do beforehand. The interesting point is that the evolutionary approach should solve this problem.
Whether you agree or not that EP is useful, facts are:

1) Traditional procurement has not given an acceptable result in the CCIS domain
2) NIAG[6] has been asked to study the consequences should NATO wish to use this approach.

I would like to finish this topic with a User demand (or rather command) that is questioned by many. It even can be questioned whether there is a market pull. The keyword here is Ada. Let me be brief. We use Ada for wargames and in a test tool. We think Ada is a better language then many others including C.

Again whether you agree or not is not too important. Facts are:

1) Ada is demanded by the US-DoD, by NATO and by some MoD's in Europe, including the Netherlands shortly.
2) Demanding Ada has resulted in commercial availability of many industrial quality Ada compilers.
3) Compared to C Ada has not been accepted by the market, despite of the demandss. It is, however, interesting to note that again a change is noticeable this time for Space and Aerospace applications. Also noteworthy is that Xerox has chosen to use Ada for its copiers. That policy will be explained on Tri-Ada.....

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[5] Command Control Information Systems

[6] NATO industrial Advisory Group

A number of other user stimulations -with the exception of MAP/TOP by Boeing- still have to occur. Examples include POSIX compliance required by the US government as of January 1992 and, I believe, MIA[7] compliance required by Nippon Telegraph and Telephone, one the world's largest companies, as of September 1992.
For PCTE, the least we can do is to look and learn from the Ada situation and then take appropriate action.

IV. USER REQUIREMENTS

The last topic I want to discuss is user requirements. Very recently we have had a discussion at our laboratory about a standard CASE tool. This discussion was held at management level (division management and board of directors). From that discussion I can validate three well known requirements and can state one derived requirement.

First point in the discussion was that the FEL-divisions use a diversity of equipment, however, we have standardized on three computer lines. The requirement here is tool portability. It is a very clear requirement for departmental and divisional managers. However, it may not be that clear for an individual project manager.

Second point in the discussion was education. To be precise: you have to distinguish a method from a tool supporting the method. For example, the method may be Yourdon or Ward and Mellor, the supporting tool may be coming from many different tool suppliers.
It is quite clear that environment education has to do with teaching people how to use a tool. Method education is a different topic and can be ignored for the purpose of this conference.
The requirement here is that we want tools with a similar user interface style: learn one tool and you can operate most tools. It certainly helps if tools use a common UIMS[8] to realize that style. HMI9 and its quality by the way is a main research area of another TNO-DR laboratory: The Institute for Perception (TNO-IZF).

The third point in our discussion indicated that there was doubt whether a single method, let alone a single tool, could support the different types of IT-work at our laboratory.
In short: an environment should support different methods and thus different tools.

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[7] Multi Vendor Integration Architecture. Specification designed by a consortium of DEC, Fujitsu, Hitachi, IBM and NEC.

[8] User Interface Management System, i.e. MOTIF, X-windows, Open Look, Open Dialogue

[9] Human Machine Interface

The last point discussed is a logical follow-on of the first two and the fact that advanced projects need project teams: if you allow different brands of equipment and need different methods and supporting tools, one needs interoperability of tools in a heterogeneous network to support teams. I leave it to you to judge whether those requirements are met by the current first generation of CASE tools. You also have to judge whether you leave meeting these requirements to each individual tool supplier or to an architecture like a PCTE based framework.

V. CONCLUSION

Ladies and gentlemen, perhaps I have triggered some questions for the panel discussion, in which case I have served my purpose. From the comfortable position that the experts on the panel may have to answer the questions I have triggered,

I Wish you a fruitful conference and an enjoyable stay in the Hague and declare the first international conference devoted to PCTE open.

Thank you for your attention.

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